

## VARIOUS IDEAS TO INTEGRATE MATHEMATICS, SCIENCE AND TECHNOLOGY IN THE CLASSROOM

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During the fall of 2007, a graduate-level mathematics and science course served as a platform to further integrate technology and engineering within a single framework of educational practice. Participants were in-service mathematics or science teachers who were deeply committed to expanding their area of expertise across the STEM fields.

Science, Technology, Engineering and Mathematics (STEM) teaching is a critical issue in our nation's educational landscape. Large-scale studies such as the National Assessment of Educational Progress (NAEP) or the Trends in International Mathematics and Science Study (TIMSS) indicate that U.S. students are not amongst the strongest contenders for leadership in either mathematics or science. Similarly, the preparation and continued education of mathematics and science teachers has increasingly become critical in that the need for these teachers by far exceeds the number of individuals in the field.

This paper reports on the experiences of two university faculty members, one in mathematics education in the College of Science, the other in science and technology education in the College of Education and Human Development, involved in the teaching of pre- and in-service teachers. During the fall semester of 2007, two of their courses were cross-listed to provide a platform for integration across STEM contexts. The decision to pursue that opportunity was based on several recognitions: (1) the integrated approach serves to simultaneously address mathematics, science, and technology standards; (2) setting mathematical explorations within a conceptual science framework naturally encourages application of hands-on and minds-on problem solving approaches; and (3) the logistics of team teaching were such that the experience was enhanced by drawing on content expertise from different fields.

The textbook used for the cross-listed courses was "Integrating Mathematics, Science, and Technology: A Skill-Building Approach" (Mason, Mittag, & Taylor, 2003); a book that aimed to support an interdisciplinary teaching environment across STEM fields.

The demographics of the group, although not entirely representative of local demographics, were somewhat diverse. Of 4 male and 14 female students, 2 were African-American, 1 Asian-Pacific, 12 Caucasian, and 3 Latino. Participating graduate students were either teachers of mathematics or science in primary (2), secondary (15) or

tertiary (1) settings. The combined group met weekly in a science laboratory to explore a wide variety of STEM ideas such as motion, electricity and magnetism, thermodynamics, gas laws, and basic chemistry. In addition, students participated in two field trips: one for a robotics exploration, and the other to a local Health Science Center.

Both courses used the same syllabus and grading structure. Most of the weight was placed on in-classroom and homework (35%) and weekly reflections in an eJournal (35%). The remainder was drawn from a final exam/project (20%) and participation (10%). The final grade distribution indicated overwhelming success (11 A, 5 B, 2 C).

Regardless of activity, and including field trips, students wrote weekly reflections in an eJournal. Specifically, they reflected on their experiences by responding to the following four prompts:

1. How do you see the integration of mathematics and science represented in the topic of the week?
2. What was beneficial to you about the class meeting? What worked?
3. What was disappointing to you about the class meeting? What did not work?
4. How can you include what you learned this week in your classroom practice?

The eJournal activity provided numerous insights into the learners' changing, or in a few cases, unchanging, beliefs and attitudes towards an integrated approach. For example, most of the mathematics teachers expressed initially a rather tentative stance towards working within a conceptual scientific framework, while the science teachers initially expressed some reservations about extensive technology-integration. However, by the end of the semester, nearly everyone in both of these groups wrote about becoming increasingly comfortable with the interdisciplinary approach.

A surprising outcome of the study was that scores for reflections largely predicted course grades; even more than the equally weighted in-class and homework component. Students who consistently wrote meaningful reflections, regardless of whether these were largely positive or negative in tenor, received higher grades overall (Figure 1).

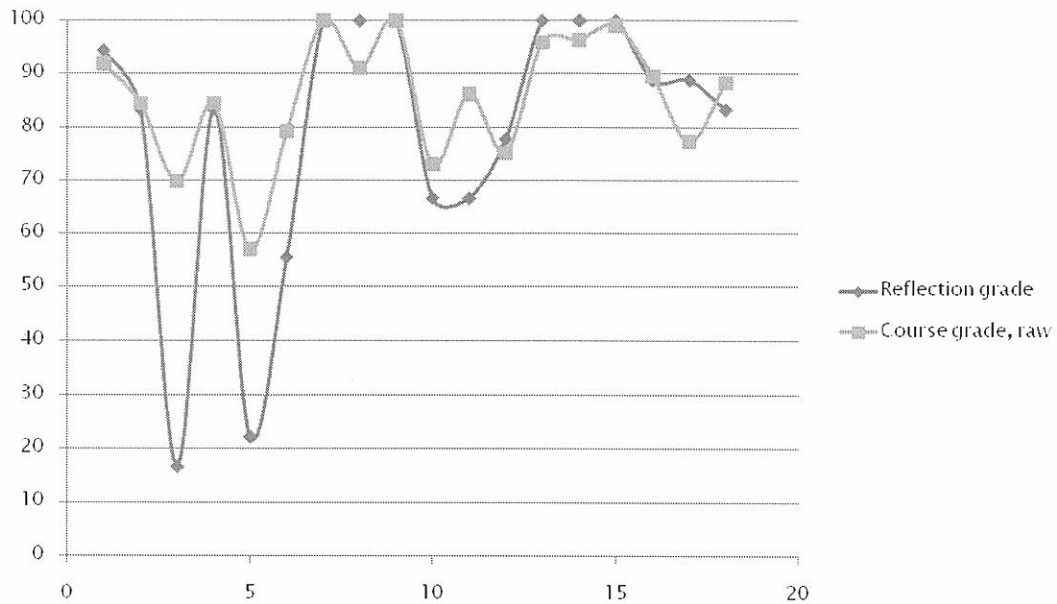


Figure 1: Reflection and raw course grades for the group

In conclusion, although the experience of this integrated mathematics and science approach appears to have had a positive outcome in terms of how teachers viewed the discipline they were less familiar with, the benefit of the course was dependent on the learner's disposition towards processing the in-class experience in a reflective manner. This finding strengthens the case for building such requirements into course work across program areas in general and into STEM education programs in particular.

Reference:

Mason, D., Mittag, K. C., & Taylor, S. E. (2003). *Integrating Mathematics, Science, and Technology: A Skill-Building Approach*. Boston: Pearson Education, Inc.